LA-UR-19-29622

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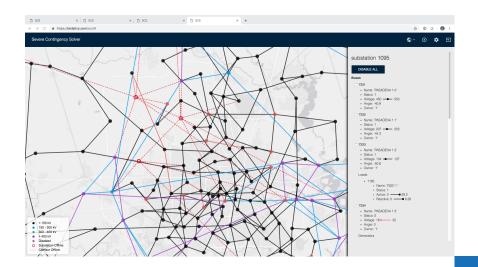
Title:	SEVERE CONTINGENCY SOLVER
Author(s):	Coffrin, Carleton James
Intended for:	Web
Issued:	2019-09-24

SEVERE CONTINGENCY SOLVER

Electric Power Transmission Analysis

SUMMARY

Los Alamos researchers have developed the Severe Contingency Solver (SCS) to help power network operators and policy makers better understand the vulnerabilities of electric power transmission systems to extreme events, such as hurricanes, ice storms, and earthquakes. It guarantees a solution for power networks with hundreds to thousands of damaged components. SCS supports multiple platforms (e.g., Linux, Windows, Mac OS X) and removes the need for human intervention when analyzing severely damaged power networks. The information can be used to prepare for extreme events and plan network upgrades for improved network resilience.

MARKET

Extreme events can cause widespread power system damage. During Hurricane Harvey more than 2 million customers lost power and 850 transmission structures and 90 substations were damaged. Recent mandates from the regulatory bodies Federal Energy Regulatory Commission (FERC) and North American Electric Reliability Corporation (NERC) focus on understanding extreme event vulnerabilities to plan future power transmission systems. Analyzing and understanding the impact of extreme events on a power system is a challenging computational task taking hours of meticulous by-hand data manipulation for subject matter experts. SCS removes the need for human analysis and fills the market gap for an accessible and intuitive option to model extensive power network effects.

BENEFITS

The Severe Contingency Solver leverages novel computational methods developed at Los Alamos National Laboratory to eliminate the need for by-hand data manipulation and enable large scale automated analysis of extreme events on the power system. SCS determines how much power must be removed to operate the network in a stable operating condition.

- Extreme event analysis
- Multi-Component contingencies
- Computing across platforms and Cluster Computing
- Multi-Scenario analysis
- Guaranteed solution
- Fast calculation time
- No human intervention
- Improved situational awareness
- Interactive vulnerability investigation

CONTACT

Kaelyn Badura
kbadura@lanl.gov
505-665-8032

WHY WE ARE BUILDING SEVERE CONTINGENCY SOLVER

The Severe Contingency Solver determines the impact on the power grid when extreme events occur. SCS computes the maximum amount of power that can be delivered in a severely damaged power network, subject to real-world operating requirements (e.g., limits of voltage, line flow, and generator capability). It determines what loads should be dropped to resupply power without violating critical operational constraints. The guaranteed solution removes the need for human intervention, reduces the analysis time from hours to just a few minutes, and increases the number of damage scenarios that can be considered from a handful to hundreds or thousands. These advantages are crucial to meeting the demand for improved modeling capability in support of grid resiliency.

WHAT'S BEHIND OUR TECHNOLOGY

The Severe Contingency Solver leverages novel power system analysis methods developed at Los Alamos National Laboratory, which are built on recent advances in non-linear optimization and convex relaxations of the power flow equations. SCS is guaranteed to produce a solution and provide a good estimate for which network components should be removed and which loads should be dropped from the network. The methodology has been peer-reviewed and published in IEEE Transactions on Power Systems.

OUR COMPETITIVE ADVANTAGES

The Severe Contingency Solver is the only software that was designed specifically for extreme event analysis where hundreds of power network components are out of service. SCS is available as open-source, enabling users to understand the modeling assumptions and make modifications to their specific use. SCS is cross platform and can run on Windows, OS X, and Linux, which makes it easy to deploy on desktop computers, clusters, and the cloud. The time to result for analysis is reduced from several hours to just a few minutes, and hundreds to thousands of vulnerability damage scenarios can be calculated quickly.

OUR TECHNOLOGY STATUS

The Severe Contingency Solver is a mature and established technology that has been validated on tens of thousands of extreme event scenarios. The methods have been peer-reviewed and published in top scientific journals. The software is well tested and has been deployed as a web service on Amazon Web Services, which government agencies use to assess network vulnerabilities. We are willing to consider consulting-type arrangements to assist in end user training and/or application of the solver to a particular problem set.

PUBLICATIONS AND IP

Multi-Infrastructure Control and Optimization Toolkit (MICOT) project, Copyright 2016, Triad National Security, LLC.
https://github.com/lanl-ansi/PowerModelsMLD.jl

Coffrin, R. Bent, B. Tasseff, K. Sundar, S. Backhaus. *Relaxations of AC Maximal Load Delivery for Severe Contingency Analysis,* IEEE Transactions on Power Systems*, 34 (2):* 1450-1458, 2019; DOI: 10.1109/TPWRS.2018.2876507